

CONTRIBUTIONS
FROM THE
CUSHMAN LABORATORY
FOR
FORAMINIFERAL RESEARCH

VOLUME 7, PARTS 2 & 3
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Contents

	PAGE
No. 103. New Late Tertiary Foraminifera from Vitilevu, Fiji	25
No. 104. A New <i>Virgulina</i> from the Miocene of Florida	32
No. 105. Cretaceous Foraminifera from Antigua, B. W. I.	33
No. 106. Additional Localities of the "Challenger" Foraminifera	46
Recent Literature on the Foraminifera	48
No. 107. Some New Tertiary Foraminifera from Texas	51
No. 108. Three New Upper Eocene Foraminifera	58
No. 109. A New <i>Plectofrondicularia</i> from Florida	60
No. 110. Notes on the Foraminifera Described by Batsch in 1791	62
Recent Literature on the Foraminifera	72

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CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

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These Contributions will be issued quarterly. They will contain short papers with plates, describing new forms and other interesting notes on the general research work on the foraminifera being done on the group by the workers in this laboratory. New literature as it comes to hand will be briefly reviewed.

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CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

103. NEW LATE TERTIARY FORAMINIFERA FROM VITILEVU, FIJI

BY JOSEPH A. CUSHMAN

The few species described here are all from the Island of Vitilevu, Fiji, collected by Dr. H. S. Ladd. The material in general represents a *Globigerina*-ooze, and is very rich in foraminifera. Most of these have already been described either by Brady in his work on the "So-called Soapstone of Fiji," or in other papers such as that of Schwager from Kar Nikobar, or described from other sources. Many of the species are also recorded by Karrer from the Late Tertiary of Luzon, Philippines, by Schubert from the Pliocene and Pleistocene of the Bismarck Archipelago, and by Koch from the Late Tertiary of Java and East Borneo. The fauna is a widely distributed one in the Late Tertiary of the Indo-Pacific, and most of the species are still living in the same general area.

In the working up of this paper, it has been of great help to have at hand a portion of the original collection of material from Kar Nikobar studied by Schwager, and from which I have been able to obtain topotype specimens of many of Schwager's species.

It has seemed best to describe these few new forms while awaiting the publication of the complete paper which will appear with the others of the series on this collection from Fiji. My thanks are due to Dr. Herbert K. Gregory of the Bishop Museum, Honolulu, and to Dr. H. S. Ladd for permission to publish these species before the appearance of the final paper. The types of these new forms are to be deposited in the U. S. National Museum.

Family TEXTULARIIDAE

Subfamily 1. Spiroplectammininae

Genus SPIROPLECTAMMINA Cushman, 1927

SPIROPLECTAMMINA PARALLELA Cushman, n. sp.

Plate 4, figures 1 *a, b*

Test elongate, slender, sides nearly parallel for most of the length, compressed, periphery acute; early portion composed of planispirally coiled chambers, later ones biserial, fairly distinct, not inflated, often 8-10 pairs in the adult; sutures fairly distinct, very slightly depressed, oblique; wall of fine sand grains with much cement; aperture at the base of the inner margin of the chamber, textularian. Length 0.65 mm.; breadth 0.20 mm.; thickness 0.10 mm.

Holotype from 1½ miles south of Suva P. O., less than ¼ mile from coast, 10' above high tide, Fiji. Collected by H. S. Ladd.

This species occurs in the Late Tertiary of the Pacific region and is still living in the Pacific. It has been referred to as "*Spiroplecta annectens*," but is not that species from the Liás. Brady records it fossil from Fiji (Quart. Journ. Geol. Soc., vol. 44, 1888, p. 5).

Family LAGENIDAE

Subfamily 2. Lageninae

Genus LAGENA Walker and Jacob, 1798

LAGENA SCHWAGERIANA Cushman, n. sp.

Plate 4, figure 2

Lagena formosa SCHWAGER (part), *Novara-Exped.*, Geol. Theil, vol. 2, 1866, p. 206, pl. 4, figs. 19 *b, c* (not *a, d*).

Test with a central body and a peripheral fringe, the latter marked by numerous fine tubules extending out in a radial manner, the body of the test smooth and without a definitely raised border, apertural end with a definite neck ending in a broad, raised, hood-like structure confluent with the peripheral fringe. Length 0.35-0.75 mm.; breadth 0.25-0.50 mm.

Holotype from the Pliocene of Fiji, collected by Dr. H. S. Ladd.

This species is very different from the typical form of *Lagena formosa* described by Schwager and already noted. The apertural end, the ornamentation and the keel are all very different.

LAGENA SPIRO-STRIOLATA Cushman, n. sp.

Plate 4, figure 3

Lagena lineata SIDEBOTTOM (part) (not WILLIAMSON), Journ. Quekett Micr. Club, ser. 2, vol. 11, 1912, p. 387, pl. 15, fig. 15.

Test often slightly longer than broad, the apertural end not extended; wall ornamented by numerous fine costae arranged in a spiral manner. Length 0.30 mm.; breadth 0.20 mm.

Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

Our specimen, as will be seen by the figure, agrees very closely with that figured by Sidebottom in the above reference from the Southwest Pacific. It is evidently a species to be looked for in the Late Tertiary and Recent collections from the general Indo-Pacific region.

LAGENA SPINO-ALATA Cushman, n. sp.

Plate 4, figure 4

Test subglobular, slightly broader toward the base, the periphery with a peculiarly shaped keel consisting of four parts, outer ones somewhat hollow, and the two central ones flattened and toothed; wall smooth or punctate. Length 0.25 mm.; breadth with spines 0.30 mm.

Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

This is a very beautifully ornamented little species which might best be referred to *Entosolenia*. Similarly ornamented forms have been referred to *Lagena alveolata* by some authors.

LAGENA BASI-STRIATULA Cushman, n. sp.

Plate 4, figure 5

Test elongate, fusiform, greatest breadth toward the base, 5 or 6 times as long as broad, base ending in a spine, apertural end extended into a tapering, cylindrical neck, surface ornamented by elongate pits arranged more or less in lines, the basal portion with numerous distinct longitudinal costae. Length 0.50 mm.; breadth 0.10 mm.

Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

This is a very distinct, ornamented species which occurs in some numbers in the Fiji collections.

Family NONIONIDAE

Genus NONION Montfort, 1808

NONION GALEATA Cushman, n. sp.

Plate 4, figures 7 *a*, *b*

Test close coiled, bilaterally symmetrical, somewhat compressed, the periphery very broadly rounded, sides deeply umbilicate; chambers 10-12 in number, distinct, slightly inflated, the inner end projecting into the central depression; sutures distinct, slightly depressed, very slightly curved; wall smooth, except about the umbilical depression where there are, in the early chambers, roughened areas at the inner part of each chamber; aperture broad and low, extending completely along the base of the final chamber, and with a slight lip, the sides of the chamber extending somewhat outwardly over the umbilical depression. Length 0.65 mm.; breadth 0.35 mm.

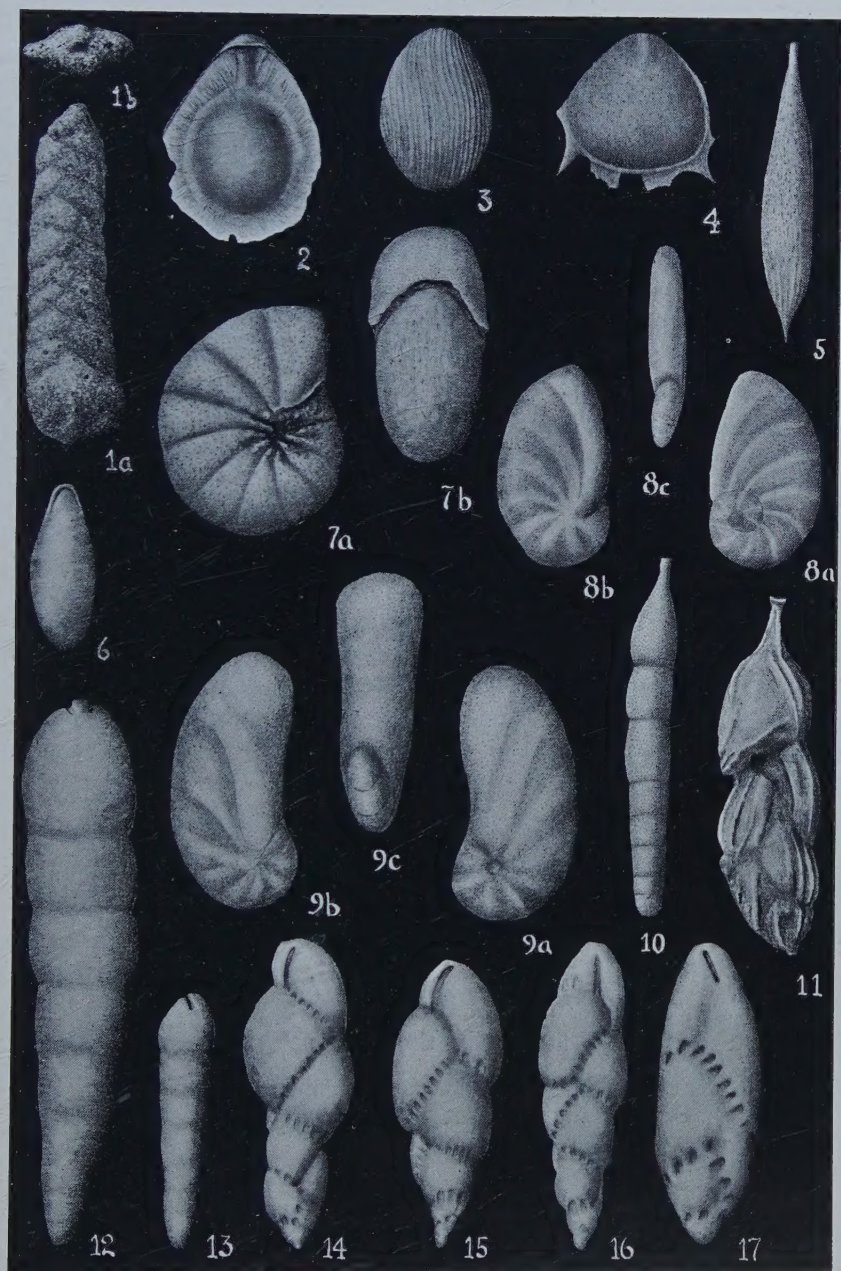
Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

The form of the chambers in this species is peculiar and reminds one strongly of the German war helmet. The umbilical region is also distinctive.

EXPLANATION OF PLATE 4

- FIGS. 1 *a*, *b*. *Spiroplectammina parallela* Cushman, n. sp. $\times 50$. *a*, side view; *b*, apertural view.
- FIG. 2. *Lagena schwageriana* Cushman, n. sp. $\times 60$.
- FIG. 3. *Lagena spiro-striolata* Cushman, n. sp. $\times 60$.
- FIG. 4. *Lagena spino-alata* Cushman, n. sp. $\times 60$.
- FIG. 5. *Lagena basi-striatula* Cushman, n. sp. $\times 60$.
- FIG. 6. *Ellipsolagena fijiensis* Cushman, n. sp. $\times 60$.
- FIGS. 7 *a*, *b*. *Nonion galeata* Cushman, n. sp. $\times 50$. *a*, side view; *b*, peripheral view.
- FIGS. 8 *a-c*. *Nonionella limbato-striata* Cushman, n. sp. $\times 50$. *a*, *b*, opposite sides; *c*, peripheral view.
- FIGS. 9 *a-c*. *Nonionella clavata* Cushman, n. sp. $\times 50$. *a*, *b*, opposite sides; *c*, peripheral view.
- FIG. 10. *Siphonodosaria fijiensis* Cushman, n. sp. $\times 65$.
- FIG. 11. *Angulogerina fijiensis* Cushman, n. sp. $\times 90$.
- FIGS. 12, 13. *Nodosarella pacifica* Cushman, n. sp. $\times 18$. Fig. 12, microspheric form. Fig. 13, megalospheric form. Fig. 12. Holotype.
- FIGS. 14-16. *Virgulina miocenica* Cushman and Ponton, n. sp. $\times 50$. Fig. 16, Holotype.
- FIG. 17. *Virgulina gunteri* Cushman. $\times 50$.

Figures drawn by Margaret S. Moore.



Genus *NONIONELLA* Cushman, 1926*NONIONELLA LIMBATO-STRATA* Cushman, n. sp.

Plate 4, figures 8 a-c

Test much longer than broad, trochoid, completely involute on the ventral side, whole test compressed, very narrow in peripheral view, the periphery rounded; chambers distinct, 8-10 in number in the last-formed coil, gradually increasing in length, especially in the last few chambers, not inflated; sutures distinct, curved, limbate, very broad on the ventral side; wall smooth, finely perforate; aperture, a narrow slit at the base of the apertural face. Length 0.30 mm.; breadth 0.15 mm.; thickness 0.06 mm.

Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

This is a small but very distinct species, and the broad sutures being of peculiar type will at once distinguish it from other species of the genus.

NONIONELLA CLAVATA Cushman, n. sp.

Plate 4, figures 9 a-c

Test elongate, broadest near the outer end, making the shape in peripheral view clavate, periphery very broadly rounded; chambers 8-10 in the last-formed coil, distinct, the later ones very much elongated; sutures distinct, limbate, slightly curved; wall smooth, finely perforate; aperture, a very narrow slit at the base of the apertural face. Length 0.55 mm.; breadth 0.30 mm.; thickness 0.18 mm.

Holotype from the Pliocene of Fiji, collected by H. S. Ladd.

This is a very peculiarly shaped species, the last chambers being very greatly extended and swollen at the outer end. The test is not entirely bilaterally symmetrical but nearly so.

Family BULIMINIDAE

Subfamily Uvigerininae

Genus *SIPHONODOSARIA* A. Silvestri, 1924*SIPHONODOSARIA FIJIENSIS* Cushman, n. sp.

Plate 4, figure 10

Test elongate, slender, very slightly tapering, base broadly rounded; chambers 6-10 in number, very slightly inflated especially toward the apertural end, partially involute, the later ones increasing somewhat in length; sutures distinct, very slightly depressed; wall smooth, except for

rather prominent perforations or depressions of the surface giving a peculiar, pearly appearance to the test; apertural end extended into a slightly tapering, elongate, tubular neck with a slight lip. Length 0.75 mm.; breadth 0.10 mm.

This is a rather handsome small species with its pearly lustre, few chambers, uniform diameter and definite tubular neck.

Genus **ANGULOGERINA** Cushman, 1927

ANGULOGERINA FIJIENSIS Cushman, n. sp.

Plate 4, figure 11

Test elongate, tapering rapidly at the ends; chambers triserial, generally triangular in section, the later ones somewhat separated from adjacent ones, the lower side excavated; sutures distinct, depressed; wall ornamented by longitudinal costae, several grouped at the angles of the chambers; apertural end produced into a slightly tapering, tubular neck with longitudinal costae, the outer end with a definite lip. Length 0.60 mm.; breadth 0.15 mm.

This is a distinctive species with its somewhat separated chambers and peculiar ornamentation. Brady records *Uvigerina porrecta* from Fiji, but ours is very different from that species.

Family **ELLIPSOIDINIDAE**

Genus **NODOSARELLA** Rzehak, 1895

NODOSARELLA PACIFICA Cushman, n. sp.

Plate 4, figures 12, 13

Test elongate, slightly tapering, the last-formed chamber having the greatest diameter, rounded in transverse section; early chambers, at least in the microspheric form, showing traces of the biserial character but later ones all uniserial, slightly involute, later chambers somewhat inflated; sutures but little depressed; wall smooth; aperture, a narrow opening with a slightly hooded upper edge or even double in the large specimens. Length of microspheric form 4.00 mm.; breadth 0.95 mm.

The megalospheric form is much smaller and has fewer chambers, usually showing little trace of the biserial arrangement in the young. The microspheric form grows to large size.

Genus ELLIPSOLAGENA A. Silvestri, 1923

ELLIPSOLAGENA FIJIENSIS Cushman, n. sp.

Plate 4, figure 6

Test small, compressed, obovate, greatest width toward the base; single chambered; wall smooth; aperture elongate, with one side forming a distinct hood. Length 0.25 mm.; breadth 0.10 mm.

This is a very small, somewhat elongate, compressed species. It is to be looked for elsewhere in the Late Tertiary of the Indo-Pacific.

104. A NEW VIRGULINA FROM THE MIOCENE OF
FLORIDA

BY JOSEPH A. CUSHMAN and GERALD M. PONTON

In the Choctawhatchee marl of Florida there occurs a species of *Virgulina* which has recently been described as *V. gunteri* Cushman. Notes in regard to this species are given on Page 44 of Bulletin 4, Florida Geological Survey, 1930. The close relation of this species to *V. pertusa* Reuss from the Miocene and Pliocene of western Europe is noted. *V. gunteri* is a much smaller and more slender species, having a definite fusiform shape.

During further work on the other portions of the Miocene of Florida the junior author has found abundant material of another species of *Virgulina* related to *V. pertusa* Reuss and *V. gunteri* Cushman. This species is abundant in the Shoal River and rare in the Oak Grove marls. It is very different in shape from *V. gunteri* (Pl. 4, fig. 17), having its greatest width toward the apertural end, but being much more slender and tapering as well as smaller than *V. pertusa* Reuss of Europe. This new species also occurs further to the north in the Miocene of Chesapeake Beach, Maryland, and probably elsewhere. A description of it follows:

VIRGULINA MIOCENICA Cushman and Ponton, n. sp.

Plate 4, figures 14-16

Test elongate, slender, somewhat compressed, gradually tapering from the subacute initial end to the greatest breadth formed by the last two chambers, somewhat twisted; chambers numerous, distinct, inflated; sutures distinct, depressed, marked by numerous depressions, the sides

of which extend backward to the preceding chamber in short distinct processes; wall except for the markings of the sutures smooth, very finely perforate; aperture very elongate, narrow, slightly curved, running from nearly the apex of the last-formed chamber to the inner margin. Length 0.75-0.90 mm.; breadth 0.25-0.30 mm.; thickness 0.20-0.25 mm.

Holotype (Cushman Coll. No. 15481) from the Miocene, Shoal River formation, Shell Bluff, Walton County, Florida.

The species, *Virgulina miocenica* (Pl. 4, figs. 14-16), has occurred at the following localities:

Shell Bluff on Shoal River about 5 miles north of Mossy Head, Walton County, Florida. Type locality of the Shoal River formation.

Whites Creek about 8 miles south of Argyle, Walton County, Florida. Shoal River formation.

Small branch flowing into Alaquia Creek, about $\frac{1}{4}$ mile west of Alaquia (formerly called Pleasant Ridge) about $4\frac{1}{2}$ miles southwest of De Funiak Springs, Walton County, Florida. Cardium Bed, Shoal River formation.

Vaughans Creek, about $\frac{1}{4}$ mile below head, 7 miles south of De Funiak Springs, Walton County, Florida. Choctawhatchee (?) formation.

Yellow River at Old Mill, about 100 yards below highway bridge on Laurel Hill-Oak Grove road, about $\frac{1}{4}$ mile south of Oak Grove. Type locality of Oak Grove formation.

Tanners Mill (Old Senterfeit Mill), $4\frac{1}{2}$ miles southwest of Laurel Hill, Walton County, Florida. Oak Grove formation.

Miocene, Choptank formation, Chesapeake Beach, Maryland.

105. CRETACEOUS FORAMINIFERA FROM ANTIGUA, B. W. I.

BY JOSEPH A. CUSHMAN

Some little time ago Dr. T. Wayland Vaughan of the Scripps Institution of Oceanography sent me a small sample of friable White Chalk from the Island of Antigua. An examination of this showed some very interesting relationships. The number of species, while not large, is sufficient to show its very close affinity with the Craie Blanche of the

Paris Basin. Most of these species are also to be found in the Taylor marl of Texas.

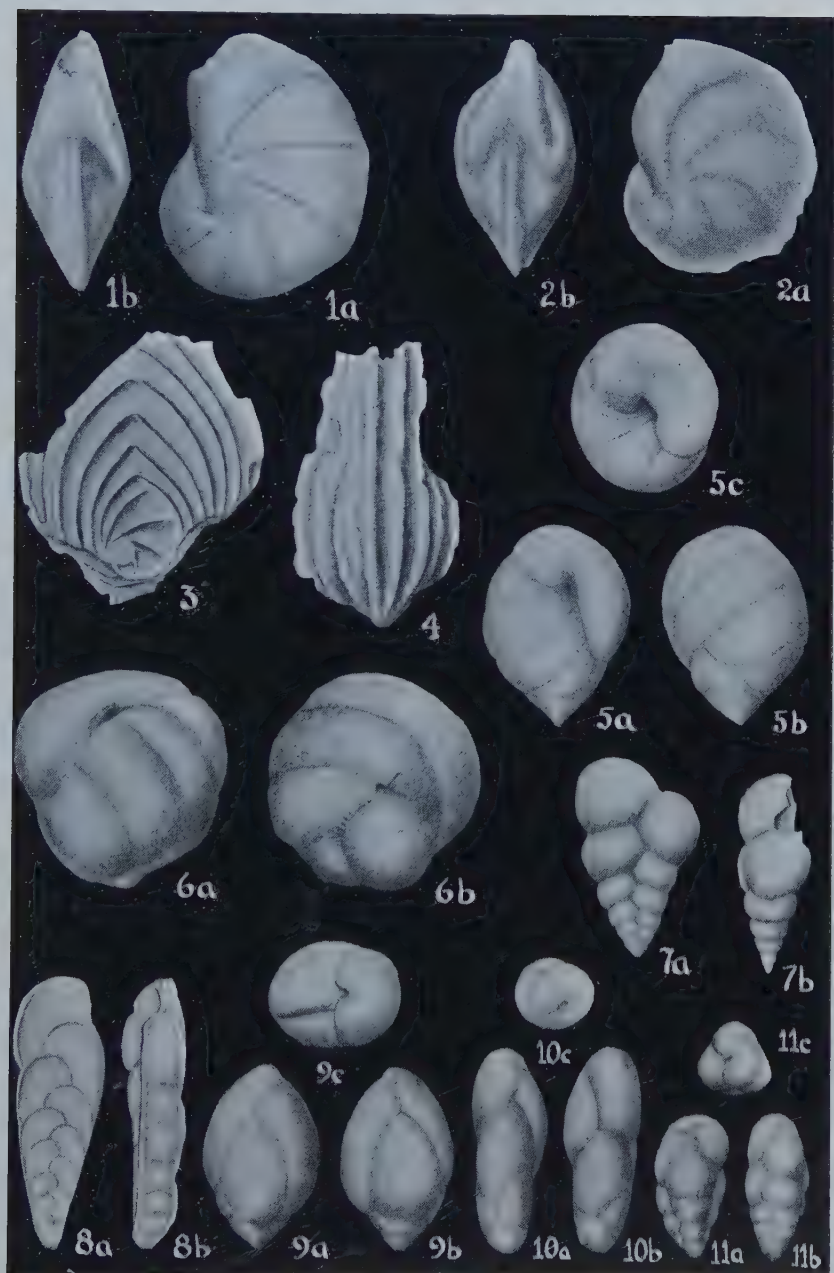
At the suggestion of Dr. Vaughan the geologist of Antigua, Mr. W. R. Forrest, collected more of the material from this locality and sent it directly to me. The material came from a dug well about 40 feet below the surface, and is a very white, fine grained chalk. The preparation of this larger amount of material gave additional species all of which confirmed the earlier ideas of its age and position in the Cretaceous section.

The occurrence of this chalk in Antigua is interesting as it is somewhat lower in the section apparently than the recently discovered Cretaceous of Trinidad, the latter being for the most part closely related to and probably the equivalent of the Velasco shale of Mexico which again is closely related to the Navarro formation of Texas. The White Chalk of Antigua is evidently considerably lower in the Cretaceous section, and represents as previously said the Craie Blanche of the Paris Basin, and is also the equivalent of portions of the Taylor marl and its equivalent in the Gulf Coastal Plain of the United States. Nearly all the species noted here have been described either by d'Orbigny from the White Chalk of the Paris Basin or by others from similar formations of

EXPLANATION OF PLATE 5

- FIGS. 1 *a, b.* *Lenticulina rotulata* Lamarck. $\times 40$. *a*, side view; *b*, peripheral view.
- FIGS. 2 *a, b.* *Robulus williamsoni* (Reuss). $\times 40$. *a*, side view; *b*, peripheral view.
- FIG. 3. *Flabellina rugosa* d'Orbigny. $\times 50$.
- FIG. 4. *Nodosaria affinis* Reuss. $\times 40$.
- FIGS. 5 *a-c.* *Arenobulimina obliqua* (d'Orbigny). $\times 50$. *a, b.* opposite sides; *c*, apertural view.
- FIGS. 6 *a, b.* *Ataxophragmium variabile* (d'Orbigny). $\times 40$. *a, b.* opposite sides.
- FIGS. 7 *a, b.* *Guembelina globulosa* (Ehrenberg). $\times 75$. *a*, front view; *b*, side view.
- FIGS. 8 *a, b.* *Bolivinita eleyi* Cushman. $\times 125$. *a*, front view; *b*, side view.
- FIGS. 9 *a-c.* *Bulimina brevis* d'Orbigny. $\times 75$. *a, b.* opposite sides; *c*, apertural view.
- FIGS. 10 *a-c.* *Bulimina imbricata* Reuss. $\times 125$. *a, b.* opposite sides; *c*, apertural view.
- FIGS. 11 *a-c.* *Bulimina puschi* Reuss. $\times 75$. *a, b.* opposite sides; *c*, apertural view.

Figures drawn by Margaret S. Moore.



central Europe. A study of this material confirms the very evident fact that our American Upper Cretaceous is for the most part identical with that of Europe, and most of the species are common to the two regions. Owing to the friable nature of the chalk many of the specimens are more or less broken, but most of them give sufficient details for their specific identification. It seems well to put these species from Antigua on record so that they may be available for those working on the distribution of Cretaceous foraminifera.

My thanks are due to Dr. T. Wayland Vaughan and to Mr. W. R. Forrest for permission to publish the species given below.

Family VALVULINIDAE

Genus ARENOBULIMINA Cushman, 1927

ARENOBULIMINA OBLIQUA (d'Orbigny)

Plate 5, figures 5 *a-c*

Bulimina obliqua D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 40, pl. 4, figs. 7, 8.

This is apparently the same species as that described by d'Orbigny from the White Chalk of the Paris Basin. It is a true *Arenobulimina*, although the material of the test is very finely arenaceous and smoothly finished. There are numerous chambers in the last-formed coil, usually five or more. The aperture is at the base of a definitely depressed area near the center of the test in end view.

The distribution of this species in the general Coastal Plain region of the United States has not yet been thoroughly worked out, but it probably will show a definite connection between the chalk of the Paris Basin, Antigua, and the Coastal Plain region.

Genus ATAXOPHRAGMIUM Reuss, 1861

ATAXOPHRAGMIUM VARIABLE (d'Orbigny)

Plate 5, figures 6 *a, b*

Bulimina variabilis D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 40, pl. 4, figs. 9-12.

This species was originally described by d'Orbigny from the White Chalk of the Paris Basin, and its specific name indicates the variable character of the species. I have much material from the chinks of the Paris Basin and elsewhere in Europe which shows that the species varies widely in shape especially in the microspheric and megalospheric forms.

The wall is distinctly arenaceous and very often has a series of narrow parallel depressions similar to those shown in Figure 6 *b*. Similar surface markings occur in a number of species of the chalks especially from those of the Island of Rügen. The chambers increase rapidly in size as they are added, the whole test being somewhat compressed, and the apertural face flattened with the aperture comparatively large and somewhat quadrate. This species is also found in the chalk facies of the general Taylor section of the Gulf Coastal Plain of Texas and elsewhere. This Antigua record, therefore, helps to fill in the gap between these two widely separated areas.

Family LAGENIDAE

Genus LENTICULINA Lamarck, 1804

LENTICULINA ROTULATA Lamarck

Plate 5, figures 1 *a*, *b*

Lenticulina rotulata LAMARCK, Ann. Mus., vol. 5, 1804, p. 188; vol. 8, 1806, pl. 62, fig. 11.

The specimen, while it is incomplete at the apertural end, is nevertheless very close indeed to this species the types of which the author examined in the collections of DeFrance at Caen. There are about eight chambers in the last-formed coil, nearly completely involute, and of uniform shape gradually increasing in size as added; the umbonal region distinctly raised. The periphery is subacute, and the sutures distinct but not depressed. The aperture in the complete forms is radiate at the peripheral angle, and has no supplementary slit in the apertural face. This species is widely recorded in many formations, but it seems to be in its typical form restricted to the Upper Cretaceous of various parts of the world. It has already been recorded from the Cretaceous of California (Cushman and Church, Proc. Cal. Acad. Sci., ser. 4, vol. 18, 1929, p. 503, pl. 37, figs. 1, 2).

Genus ROBULUS Montfort, 1808

ROBULUS WILLIAMSONI (Reuss)

Plate 5, figures 2 *a*, *b*

Cristellaria williamsoni REUSS, Sitz. Akad. Wiss. Wien, vol. 44, pt. 6, 1861 (1862), p. 327, pl. 6, figs. 4 *a*, *b*.—EGGER, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, 1899, p. 120, pl. 11, figs. 7, 8.

Lenticulina williamsoni CUSHMAN and CHURCH, Proc. Cal. Acad. Sci., ser. 4, vol. 18, 1929, p. 503, pl. 36, figs. 13, 14.

This is a widely distributed species in the Upper Cretaceous being already recorded from the Cretaceous of Europe and from the Upper Cretaceous near Coalinga, California. It also occurs in the Upper Cretaceous of Trinidad, being one of the few species that is common at these two regions.

The species has a distinct keel, comparatively few chambers, depressed and slightly curved sutures, and a smooth surface. The apertural face is distinctly concave and has raised edges, and the aperture is a supplementary slit at the upper end of the apertural face.

Genus FLABELLINA d'Orbigny, 1839

FLABELLINA RUGOSA d'Orbigny

Plate 5, figure 3

Flabellina rugosa d'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 23, pl. 2, figs. 4, 5, 7.

The figured specimen is a broken one such as is usually common wherever the species is found, the later chambers being somewhat thin and delicate. The early portion of the test is coiled, and the later chambers become distinctly frondicularian. The sutures are raised into thin, plate-like projections considerably above the general surface of the test, those of the later portion being much less prominent, and in old age specimens frequently wanting. This is the form described by d'Orbigny from the Paris Basin chalk, and which I have already recorded from the Taylor marl of Texas (Contr. Cushman Lab. Foram. Res., vol. 6, 1930, p. 32, pl. 4, fig. 15). In the American Upper Cretaceous this species is particularly characteristic of the chalk facies.

Genus NODOSARIA Lamarck, 1816

NODOSARIA AFFINIS Reuss

Plate 5, figure 4

Nodosaria affinis REUSS, Verstein. Böhm. Kreide, 1845-46, pt. 1, p. 26, pl. 13, fig. 16; in GEINITZ, Paleontographica, vol. 20, pt. 2, 1874, p. 83, pl. 20, fig. 12.—FRANKE, Abhandl. Geol. Pal. Institut. Univ. Greifswald, vol. 6, 1925, p. 37, pl. 3, fig. 25.—BERRY and KELLEY, Proc. U. S. Nat. Mus., vol. 76, Art. 19, 1929, p. 6, pl. 1, fig. 8. *Nodosaria proxima* BERRY and KELLEY (not SILVESTRI), Proc. U. S. Nat. Mus., vol. 76, Art. 19, 1929, p. 7, pl. 1, fig. 13.

The figured specimen shows only a fragment of the species, but has the proloculum complete and the second chamber nearly so. Enough of

the surface ornamentation is shown so that the species may be placed without question. This is one of the most common species in the Upper Cretaceous of the Gulf Coastal Plain of the United States and in Europe. There is a great amount of variation in the relative size and number of chambers, but the ornamentation remains fairly constant.

Family HETEROHELICIDAE

Genus GUEMBELINA Egger, 1899

GUEMBELINA GLOBULOSA (Ehrenberg)

Plate 5, figures 7 *a*, *b*

Textularia globulosa EHRENBURG, Abhandl. preuss. Akad. Wiss. Berlin, 1838, p. 135, pl. 4, fig. B.

This is one of the most widely distributed species occurring commonly in most parts of the world where Cretaceous deposits occur, especially those of the chalky type. It is a smooth form in which the chambers are rapidly but uniformly increasing in size as added.

Genus BOLIVINITA Cushman, 1927

BOLIVINITA ELEIYI Cushman

Plate 5, figures 8 *a*, *b*

Textularia obsoleta ELEY (not REUSS), Geol. in the Garden, 1859, p. 202, pl. 8, fig. 11C, (?) p. 195, pl. 2, fig. 11.—WRIGHT, Irish Nat., 1902, p. 179, List.—(?) CHAPMAN, Bull. Geol. Surv., W. Australia, No. 72, 1917, p. 16, pl. 12, fig. 116.

Bolivinita eleyi CUSHMAN, Contr. Cushman Lab. Foram. Res., vol. 2, pt. 4, 1927, p. 91, pl. 12, figs. 11 *a*, *b*.

Test somewhat rhomboid, 2 or 3 times as long as broad, greatest width formed by the last two chambers, the periphery flattened as are the other two broader faces, angles very slightly keeled; sutures somewhat indistinct, limbate; surface finely perforate.

Although not recorded by d'Orbigny from the Cretaceous chalk of the Paris Basin, nevertheless this species occurs there in many of our samples from that region as well as from the chalks of England and Ireland. It has been recorded from the Upper Cretaceous of Arkansas, and is often very common in the Upper Cretaceous of Texas in the Taylor marl, especially the chalky facies.

Genus *PSEUDOUVIGERINA* Cushman, 1927*PSEUDOUVIGERINA* sp (?)Plate 6, figures 1 *a-c*

This rather peculiarly marked species has occurred as a single specimen in the Antigua material. It is not sufficiently well preserved as to details so that it may be given a specific name, but is recorded here simply to call attention to this form.

Family BULIMINIDAE

Genus *BULIMINA* d'Orbigny, 1826*BULIMINA BREVIS* d'OrbignyPlate 5, figures 9 *a-c*

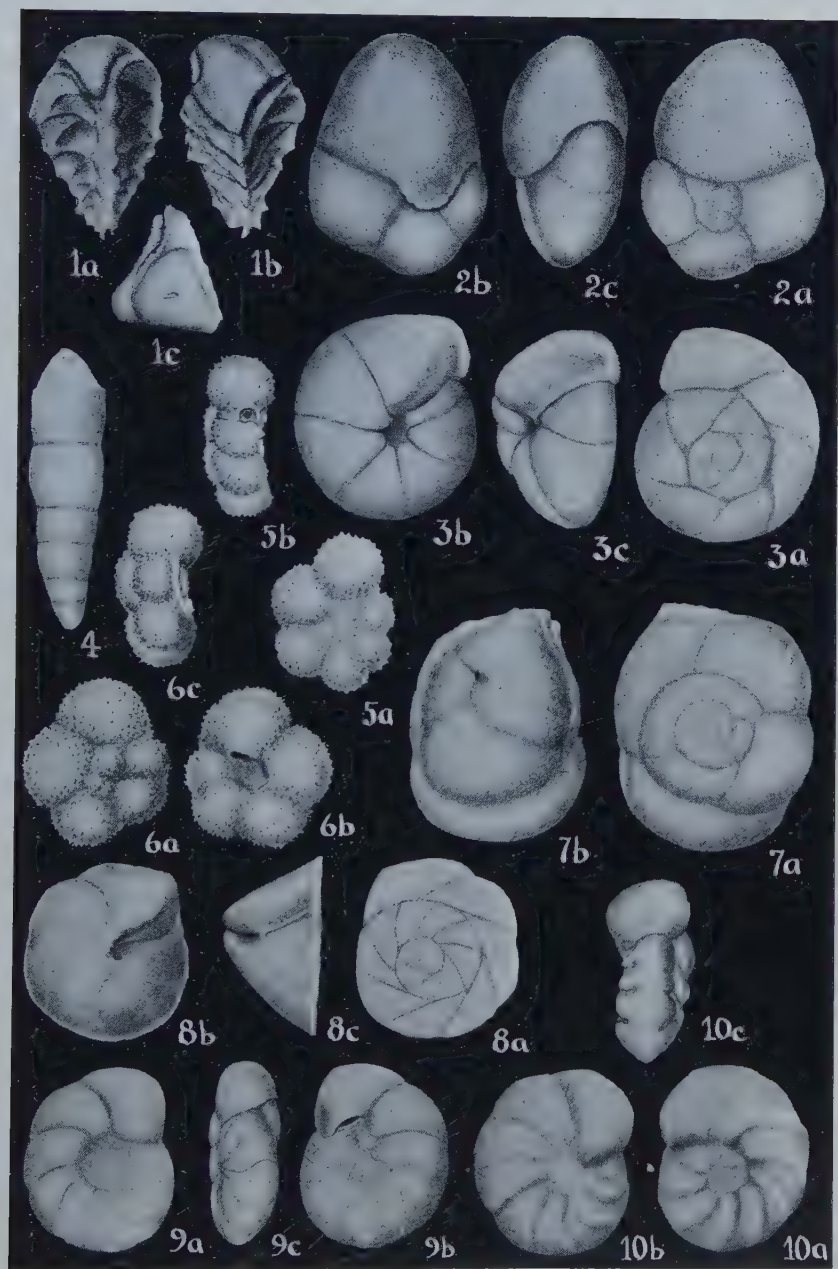
Bulimina brevis d'ORBIGNY, Ann. Sci. Nat., vol. 7, 1826, p. 270, No. 13; Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 41, pl. 4, figs. 13, 14.

d'Orbigny's figures of this species in the 1840 report are much shorter and the base more rounded than in the usual form. However, a study of our Cretaceous material from this same area seems to show that the microspheric form at least is similar to that figured here. It is a common species in the chalks of Europe and also in America. It may be

EXPLANATION OF PLATE 6

- FIGS. 1 *a-c*. *Pseudouvigerina* sp (?). $\times 75$. *a*, *b*, opposite sides; *c*, apertural view.
 FIGS. 2 *a-c*. *Valvulineria allomorphinoides* (Reuss). $\times 75$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
 FIGS. 3 *a-c*. *Gyroidina umbilicata* (d'Orbigny). $\times 75$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
 FIG. 4. *Nodosarella* sp (?). $\times 75$.
 FIGS. 5 *a, b*. *Globigerinella aspera* (Ehrenberg). $\times 75$. *a*, side view; *b*, peripheral view.
 FIGS. 6 *a-c*. *Globigerina cretacea* d'Orbigny. $\times 75$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
 FIGS. 7 *a, b*. *Globigerina elevata* d'Orbigny. $\times 45$. *a*, dorsal view; *b*, peripheral view.
 FIGS. 8 *a-c*. *Globorotalia micheliniana* (d'Orbigny). $\times 75$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
 FIGS. 9 *a-c*. *Anomalina lorneiana* (d'Orbigny). $\times 45$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
 FIGS. 10 *a-c*. *Anomalina clementiana* (d'Orbigny). $\times 45$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

Figures drawn by Margaret S. Moore.



noted here that it is very close to the forms described later by Reuss as *Bulimina ovula*. Our material, however, seems to show that these two forms are closely connected and probably identical, in which case they should be given d'Orbigny's earlier name.

BULIMINA IMBRICATA Reuss

Plate 5, figures 10 *a-c*

Bulimina imbricata REUSS, Haidinger's Nat. Abhandl., vol. 4, pt. 1, 1851, p. 38, pl. 3, fig. 7.

In 1851 Reuss described this species from the Upper Cretaceous of Lemberg. His specimen is a much more regular one than ours, but this has been placed at least provisionally under his species which seems, so far as material available shows, to be the same variable species. The later chambers are elongate, and earlier ones much shorter.

BULIMINA PUSCHI Reuss

Plate 5, figures 11 *a-c*

Bulimina puschi REUSS, Haidinger's Nat. Abhandl., vol. 4, pt. 1, 1851, p. 21, pl. 3, fig. 6.
—EGGER, Ber. Nat. Ver. Passau, 1907, p. 23, pl. 3, fig. 3.—FRANKE, Abhandl. Preuss. Geol. Landes, vol. 111, 1928, p. 159, pl. 14, fig. 18.

This is a small species, elongate and tapering, with the greatest breadth toward the apertural end. The chambers are numerous, short and subglobular, but in end view the test shows a slight tendency to become triangular. The sutures are distinct and depressed, the wall smooth, and the aperture fairly large. Reuss's species was described from the Upper Cretaceous of Europe, and it also occurs in the Upper Cretaceous of the Gulf Coastal Plain of the United States.

Family ELLIPSOIDINIDAE

Genus NODOSARELLA Rzehak, 1895

NODOSARELLA sp (?)

Plate 6, figure 4

There is a single complete specimen uniserial in its development, and with the aperture typical of this group. It is somewhat similar to the species that occur elsewhere in the Cretaceous, but without more complete specimens it is difficult to give any specific name.

Family ROTALIIDAE

Genus VALVULINERIA Cushman, 1926

VALVULINERIA ALLOMORPHINOIDES (Reuss)

Plate 6, figures 2 *a-c*

Valvulina allomorphinoides REUSS, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 223, pl. 11, figs. 6 *a-c*.

Discorbina allomorphinoides FRANKE, Abhandl. Geol. Pal. Institut. Univ. Greifswald, vol. 6, 1925, p. 91, pl. 8, figs. 11 *a, b*; Abhandl. Preuss. Geol. Landes, vol. 111, 1928, p. 189, pl. 18, figs. 7 *a, b*.

Discorbis allomorphinoides CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 606, pl. 20, figs. 18, 19; pl. 21, fig. 5.

This species is widely distributed in the Upper Cretaceous of Europe and America, and occurs in typical form in this White Chalk of Antigua. The test is biconvex, slightly longer than broad, oval, with a rounded periphery. The chambers are usually very distinct with the earlier whorls visible on the dorsal side, ventrally involute, and usually 4 or 5 chambers in the last-formed whorl. The sutures are distinct, very slightly curved on the dorsal side and slightly depressed, on the ventral side nearly radial. The wall is smooth, and the aperture a narrow slit below an overhanging, flat, plate-like lip.

Genus GYROIDINA d'Orbigny, 1826

GYROIDINA UMBILICATA (d'Orbigny)

Plate 6, figures 3 *a-c*

Rotalina umbilicata D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 32, pl. 3, figs. 4-6.

This species was originally described by d'Orbigny from the White Chalk of the Paris Basin, and seems to belong to *Gyroidina*, although it is a variable form, and some of the specimens seem to tend toward *Valvulineria*. It is identical with the Paris Basin chalk specimens which so far as I have seen never have quite the rounded form indicated in d'Orbigny's original figures. There are usually about six chambers in the last-formed whorl of the test. The ventral side is decidedly umbilicate, and the chambers themselves inflated.

Family GLOBIGERINIDAE

Genus GLOBIGERINA d'Orbigny, 1826

GLOBIGERINA CRETACEA d'Orbigny

Plate 6, figures 6 a-c

Globigerina cretacea d'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 34, pl. 3, figs. 12-14.

The published records for this species cover most formations from Cretaceous to Recent, and from many regions. It was originally described by d'Orbigny from the Paris Basin chalks, and in that and the equivalent formations of Europe, America, and elsewhere it occurs in enormous numbers, and seems to have a very definite form. The type figured has five chambers in the last-formed whorl; the spire is low, and the surface finely ornamented, with the ventral side showing a deep umbilicus. Frequently in well preserved material there is a thin, plate-like structure very largely covering the umbilical region, but this is very fragile and usually not present, although the edges of it may be seen in many specimens.

GLOBIGERINA ELEVATA d'Orbigny

Plate 6, figures 7 a, b

Globigerina elevata d'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 34, pl. 3, figs. 15, 16.

d'Orbigny's figures in the Cretaceous Monograph show a peculiar large, high spired form with rather smooth surface. I have had similar specimens from the chalk of the Paris Basin and from other localities in Europe. It has not been recorded in America from the Cretaceous, but from the specimen figured here it should be looked for, as our specimens are in many ways similar to those of d'Orbigny.

Genus GLOBIGERINELLA Cushman, 1927

GLOBIGERINELLA ASPERA (Ehrenberg)

Plate 6, figures 5 a, b

Phanerostomum asperum EHRENBURG, Mikrogeologie, 1854, pl. 30, figs. 26 a, b; pl. 32, pt. 2, fig. 42.

Globigerina aspera EGGER, Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 21, pt. 1, 1899, p. 170, pl. 21, figs. 18-20; Ber. nat. Ver. Passau, 1907, p. 49, pl. 7, fig. 27.

—FRANKE, Abhandl. Preuss. Geol. Landes., vol. 111, 1928, p. 192, pl. 18, figs. 10 a-c.
Globigerinella aspera CARMAN, Journ. Pal., vol. 3, 1929, p. 315, pl. 34, fig. 6.

This nearly bilaterally symmetrical species is very common and widely distributed in the Upper Cretaceous of America. There are usually 6 or 7 chambers in the adult, and the surface is very distinctly spinose and roughened, especially in the early chambers, the later ones being often much less spinose as the spines are progressively reduced in size as the chambers are added.

Family GLOBOROTALIIDAE

Genus GLOBOROTALIA Cushman, 1927

GLOBOROTALIA MICHELINIANA (d'Orbigny)

Plate 6, figures 8 a-c

Rotalina micheliniana D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 31, pl. 3, figs. 1-3.

This species is a very definite one in the Upper Cretaceous chalks, occurring very widely distributed in different parts of the world. The name was used by Brady for Recent material which should be referred to *Globorotalia truncatulinoides* of d'Orbigny. The Cretaceous form has a very sharp keel and a very high spire, the dorsal side usually flattened or very slightly convex, chambers numerous, in 2 or 3 whorls with usually about seven chambers in the last-formed whorl. The ventral side of the test is very deeply umbilicate, and the surface is usually smooth throughout.

Family ANOMALINIDAE

Genus ANOMALINA d'Orbigny, 1826

ANOMALINA LORNEIANA (d'Orbigny)

Plate 6, figures 9 a-c

Rosalina lorneiana D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 36, pl. 3, figs. 20-22.

The type form figured by d'Orbigny from the Paris Basin has the later chambers much inflated, and the sutures very oblique on the dorsal side. There are specimens in our collection from Antigua, one of which is figured here, which show as do the series of French specimens, a decided linking of this species with the following. In the original figures the two look very different, but there are numerous gradations which seem to show that the one may possibly be a variety of the other.

ANOMALINA CLEMENTIANA (d'Orbigny)

Plate 6, figures 10 *a-c*

Rosalina clementiana D'ORBIGNY, Mém. Soc. Géol. France, sér. 1, vol. 4, 1840, p. 37, pl. 3, figs. 23-25.

Anomalina clementiana FRANKE, Abhandl. Geol. Pal. Institut. Univ. Greifswald, vol. 6, 1925, p. 85, pl. 7, figs. 12 *a-c*; Abhandl. Preuss. Geol. Landes., vol. 111, 1928, p. 179, pl. 16, figs. 9 *a-c*.

Anomalina tennesseensis W. BERRY, in BERRY and KELLEY, Proc. U. S. Nat. Mus., vol. 76, Art. 19, 1929, p. 13, pl. 2, figs. 13-15.

This, as has already been noted under the preceding species, is a very variable form. Similar forms occur in the Upper Cretaceous of Tennessee and elsewhere in our Gulf Coastal Plain Cretaceous. There are 7 to 9 chambers in the last-formed whorl, the periphery rounded. On the ventral side, according to d'Orbigny's figure and from our specimens, the inner end of the chamber itself is often raised into a rounded elevation which extends toward the periphery in a slight curve entirely disappearing before it reaches the periphery itself. It shows very much variation, and d'Orbigny's figure seems to be an extreme one as I have never seen even in typical French chalk such a highly ornamented form.

106. ADDITIONAL LOCALITIES OF THE "CHALLENGER"
FORAMINIFERA

BY W. L. F. NUTTALL

In 1927 the writer published a paper entitled "Localities whence the Foraminifera figured in the Report of H. M. S. Challenger by Brady were derived."* Recently Dr. W. A. Macfadyen, while working in the Zoological Museum at Cambridge, England, came across some additional slides, which had become separated in a different cabinet from the Brady Collection. The localities of these, which were noted by him and checked by the writer, are given below and fill omissions in the paper referred to. The plates and figures are those of the Monograph.

PLATE IV

Fig. 10 *a*. *Miliolina insignis* H. B. Brady, Chal. Stn. 162, Bass Strait.

* Ann. Mag. Nat. Hist. (London), ser. 9, vol. XIX, 1927, p. 209-241.

PLATE VI

Fig. 14. *Miliolina pulchella* (d'Orbigny), Porcupine, No. AA, Loch Scavaig, Skye.

Fig. 18. *Miliolina linneana* (d'Orbigny), Chal. Stn. 187 A, off Booby Island.

PLATE X

Fig. 14. *Spiroloculina acutimargo* H. B. Brady, Chal. Stn. 174 A, off Kandavu, Fiji.

Fig. 15. *Idem*, Chal. Stn. 185, off Raine Is., Torres Straits.

PLATE XL

Fig. 18. *Trochammina ringens* H. B. Brady, fig. 18 *a*, Chal. Stn. 98, off west coast of Africa; fig. 18 *b*, Stn. 70, N. Atlantic.

PLATE XLI

Fig. 6. *Trochammina nitida* H. B. Brady, Chal. Stn. 145, Prince Edward Island.

PLATE LXXXV

Figs. 22, 24, 25. *Spirillina decorata* H. B. Brady, Chal. Stn. 120, off Pernambuco.

PLATE LXXXVIII

Fig. 2. *Discorbina vilardeboana* (d'Orbigny), Chal. Stn. 233 B, Inland Sea, Japan.

Fig. 3. *Discorbina patelliformis* H. B. Brady, Stn. 219 A, Admiralty Islands.

PLATE XCVII

Figs. 4, 6. *Anomalina polymorpha* Costa, Chal. Stn. 164 A, off Sydney, N. S. W.

PLATE CIII

Fig. 7. *Pulvinulina patagonica* (d'Orbigny), Chal. Stn. 302, off west coast of Patagonia (not Stn. 246, N. Pacific).

PLATE CV

Fig. 9. *Pulvinulina karsteni* Reuss, N. Polar Exped., 1875-6, Cape Frazer, Lat. 79° 45' N.

RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the foraminifera that have come to hand.

Vaughan, T. Wayland.

A Note on *Lepidocyclina hilli* Cushman.

(Journ. Pal., vol. 5, No. 1, Mar., 1931, pp. 41-42.)

Tulsa.

Notes are given on the internal structure of the type.

Thomas, A. O.

Late Devonian Foraminifera from Iowa.

(Journ. Pal., vol. 5, No. 1, Mar., 1931, pp. 40-41, pl. 7.)

Tulsa.

A new species of *Endothyra* is described and figured.

Skinner, John W.

New Permo-Pennsylvanian Fusulinidae from Northern Oklahoma.

(Journ. Pal., vol. 5, No. 1, Mar., 1931, pp. 16-22, pls. 3-4)

Tulsa.

Five new species are described and figured.

Nuttall, W. L. F., and A. G. Brighton.

Larger Foraminifera from the Tertiary of Somaliland.

(Geol. Mag., vol. 68, No. 800, Feb. 1931, pp. 49-65, pls. I-IV, figs.

1-3 [in text].)

London.

Species are described and figured from the Oligocene and Upper and Middle Eocene, with three new species.

Krijnen, W. F.

Het genus *Spiroclypeus* in het Indo-Pacifische gebied (With Summary in English).

(Verhandl. Geol.-Mijn. Gen. Nederland en Kolonien. Geol. Ser., vol. 9, 1931, pp. 77-112, pls. 1-3.)

Gravenhage.

Figures and describes the Indo-Pacific species of the genus.

Berry, Willard.

Sectioning Orbitoid Foraminifera.

(Science, vol. 73, No. 1894, Apr. 17, 1931, pp. 426-427, 4 text figs.)

Lancaster.

A simple method of sectioning is given.

Heron-Allen, Edward.

The Further and Final Researches of Joseph Jackson Lister Upon the Reproductive Processes of *Polystomella crispa* (Linné). (An Unpublished Paper Completed and Edited from His Note-Books.)

(Smithsonian Misc. Coll., vol. 82, No. 9 [Publ. 3067], Nov. 26, 1930, pp. 1-11, pls. 1-7.) Washington.

Notes on the stages in the development of megalospheric young with an excellent series of photomicrographs.

Plummer, Helen Jeanne.

Gaudryinella, A New Foraminiferal Genus.

(The American Midland Naturalist, vol. 12, No. 9, May, 1931, pp. 341, 342, figs. *a*, *b*, [in text].) Notre Dame.

Describes the above genus, derived from *Gaudryina* by the addition of a uniserial stage. Lower Cretaceous.

Chapman, F., and W. J. Parr.

Notes on New and Aberrant Types of Foraminifera.

(Proc. Roy. Soc. Victoria, vol. XLIII, pt. II, Feb. 27, 1931, pp. 236-238, pl. IX [in part].) Melbourne.

Two new genera, *Heronallenia* and *Hofkerina*, are described and figured.

Chapman, F., and W. J. Parr.

On an Anomalous Specimen of *Homotrema rubrum* (Lamarck).

(l. c., 1931, pp. 238-240, pl. IX [in part].) Melbourne.

Chapman, Frederick.

A Report on Samples Obtained by Boring into Michaelmas Reef, about 22 Miles N. E. of Cairns, Queensland.

(Reports of Great Barrier Reef Committee, vol. III, 1931, pp. 32-42, pls. IX, X.)

Lists numerous foraminifera.

J. A. C.

CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

107. SOME NEW TERTIARY FORAMINIFERA FROM TEXAS

BY JOSEPH A. CUSHMAN and ALVA C. ELLISOR

The following descriptions are of Tertiary foraminifera from Texas. They include species and varieties from the Lower Oligocene and from the Upper Eocene. Several of these are closely related to other species of the Tertiary, but have definite stratigraphic ranges to which they are restricted. The characters noted here will distinguish them from their near relatives, and make them available for close stratigraphic work.

TEXTULARIA MISSISSIPPIENSIS Cushman, var. **RHOMBOIDEA** Cushman and Ellisor,
n. var.

Plate 7, figures 1 *a, b*

Variety differing from the typical in the much thinner, flatter form and the generally rhomboid outline.

Holotype of variety (Cushman Coll. No. 15,513) from Upper Eocene, $\frac{1}{2}$ mile Southeast of Diboll, on White Oak Creek just below bridge on Club Road, Angelina County, Texas.

This Upper Eocene variety is usually easily distinguished from the Lower Oligocene one in its outline and very much compressed characters of the test.

TEXTULARIA WARRENI Cushman and Ellisor, n. sp.

Plate 7, figures 2 *a, b*

Test much compressed, broad, periphery subacute, median line somewhat raised, outline generally rhomboid; chambers distinct, fairly num-

erous, low and broad; sutures distinct, slightly raised, meeting in a definite, raised area along the middle, slightly curved, the inner portion forming an angle from 20-25° with the median line, slightly more curved toward the periphery; wall distinctly arenaceous with considerable proportion of cement, and rather smoothly finished; aperture small, in the median line at the base of the last-formed chamber. Length up to 1.20 mm.; breadth 0.60-0.95 mm.; thickness 0.25 mm.

Holotype (Cushman Coll. No. 15,514) from the Lower Oligocene, Vicksburg, from core sample, Humble Oil and Refining Company's Well No. 73 Sims Smith, at 5,795-5801 feet, Goose Creek, Harris County, Texas.

This is a very distinctive species in the Lower Oligocene material. The general form in appearance is well shown in the illustration, and the species should be an easily distinguished one.

TROCHAMMINA TEASI Cushman and Ellisor, n. sp.

Plate 7, figures 3 *a-c*

Test trochoid, low, the periphery rounded; chambers distinct, about four making up the last-formed whorl in the adult, but in the younger stages 5 or 6 making up a whorl; sutures fairly distinct, oblique on the dorsal side, nearly radial on the ventral, slightly depressed; wall finely arenaceous, slightly roughened on the surface; aperture a low elongate slit on the ventral side between the umbilicus and the periphery. Diameter 0.45 mm.; height 0.07-0.10 mm.

Holotype (Cushman Coll. No. 15,515) from Upper Eocene, core sample from Humble Oil and Refining Company's No. 12 Thompson, 3,313-3,320 feet, Raccoon Bend, Austin County, Texas.

This seems to be a well characterized species which has the number of chambers in a whorl distinctly decreasing with the development of the test.

NONION LAEVIS (d'Orbigny), var. **MARGINATUM** Cushman and Ellisor, n. var.

Plate 7, figures 5 *a, b*

Variety differing from the typical in the very distinct, somewhat thickened, marginal keel and the subacute to acute periphery.

Holotype of variety (Cushman Coll. No. 15,516) from Upper Eocene, Dubois Ranch, on Sandies Creek, East of Sample, Gonzales County, Texas.

This form which is often common in the Upper Eocene of the general Coastal Plain region, may be distinguished by the very distinct keel. In its general characteristics it is nearest to d'Orbigny's species which was described from the Tertiary of the Paris Basin. It is close to *Nonion advenum* (Cushman) of the Lower Oligocene.

ELPHIDIUM EOCENICUM Cushman and Ellisor, n. sp.

Plate 7, figures 6 *a, b*

Test small, biconvex, periphery broadly rounded, the umbilical region slightly depressed; chambers distinct, somewhat inflated, typically eight in the last-formed coil, of rather uniform size and shape; sutures distinct, depressed, very slightly curved, retral processes distinct, usually 9 or 10 visible along each suture in side view; wall smooth, finely perforate; aperture consisting of several small pores along the base of the apertural face. Diameter 0.30 mm.; thickness 0.10-0.12 mm.

Holotype (Cushman Coll. No. 15,517) from the Upper Eocene, North-east Corner of Survey No. 27, Jurisdiction of Mier, Starr County, Texas.

This species is probably nearest to *Elphidium minutum* (Reuss) described from the Later Tertiary of Europe, but seems to be distinct from that species. It has invariably fewer chambers than *E. texanum* (Cushman and Applin), and the retral processes are much more distinct and well developed.

MASSILINA PRATTI Cushman and Ellisor, n. sp.

Plate 7, figures 4 *a-c*

Massilina sp (?) CUSHMAN and APPLIN, Bull. Amer. Assoc. Petr. Geol., vol. 10, 1926, p. 185, pl. 10, figs. 25-27.

Test slightly longer than broad, much compressed, periphery distinctly keeled; chambers distinct, projecting at both ends so that the apertural end has a short cylindrical neck, usually six chambers visible on each side in the adult, each chamber inflated in the middle, and compressed toward the sides; sutures distinct, slightly depressed; wall smooth; aperture subcircular with a simple tooth. Length 0.60-0.80 mm.; breadth 0.45-0.50 mm.; thickness 0.10 mm.

Holotype (Cushman Coll. No. 15,518) from Upper Eocene, core sample from Humble Oil and Refining Company's No. 12 Thompson, at 3,313-3,320 feet, Raccoon Bend, Austin County, Texas.

This is a rather widely distributed species in the Upper Eocene of the general Coastal Plain region. It is unornamented, and the general form of the chambers well distinguished.

UVIGERINA VICKSBURGENSIS Cushman and Ellisor, n. sp.

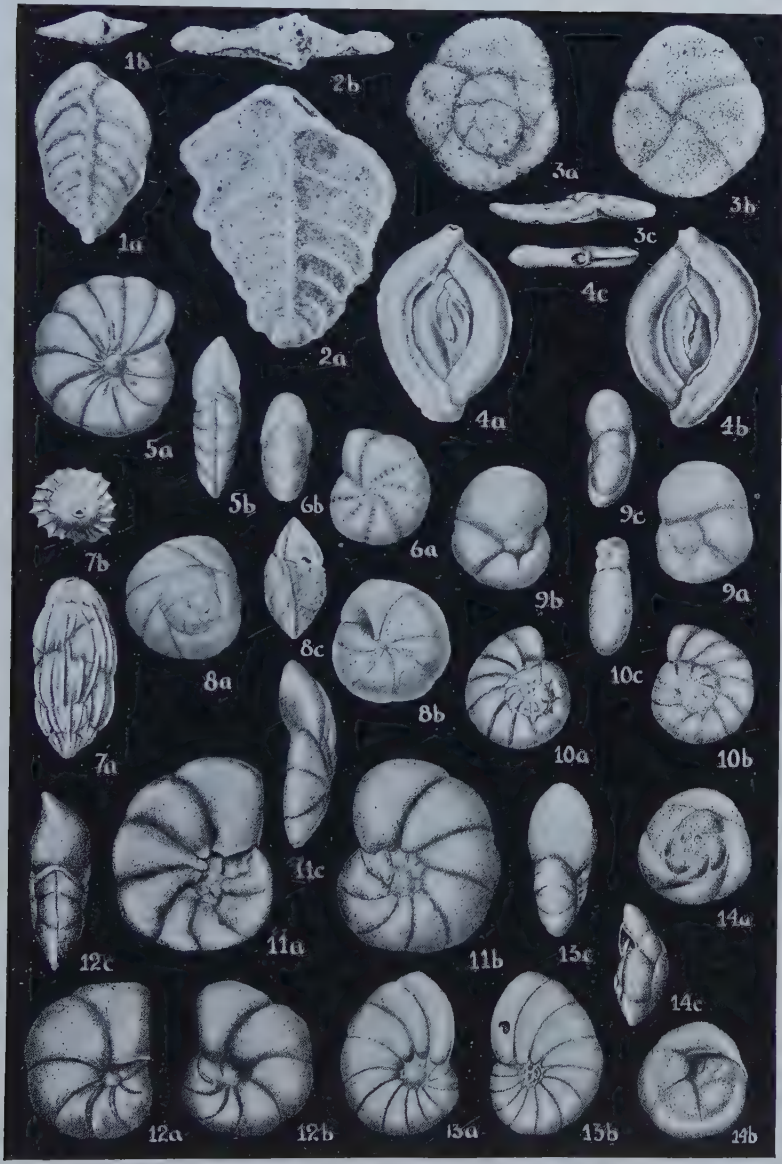
Plate 7, figures 7 *a*, *b*

Test elongate, 2-2½ times as long as broad, nearly circular in end view; chambers numerous, fairly distinct, only slightly inflated; sutures fairly distinct, slightly depressed; wall ornamented by numerous, slightly

EXPLANATION OF PLATE 7

- FIGS. 1 *a*, *b*. *Textularia mississippiensis* Cushman, var. *rhomboidea* Cushman and Ellisor, n. var. $\times 40$. *a*, front view; *b*, apertural view.
- FIGS. 2 *a*, *b*. *Textularia warreni* Cushman and Ellisor, n. sp. $\times 35$. *a*, front view; *b*, apertural view.
- FIGS. 3 *a-c*. *Trochammina teasi* Cushman and Ellisor, n. sp. $\times 60$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 4 *a-c*. *Massilina pratti* Cushman and Ellisor, n. sp. $\times 40$. *a*, *b*, opposite sides; *c*, apertural view.
- FIGS. 5 *a*, *b*. *Nonion laevis* (d'Orbigny), var. *marginatum* Cushman and Ellisor, n. var. $\times 60$. *a*, side view; *b*, peripheral view.
- FIGS. 6 *a*, *b*. *Elphidium eocenicum* Cushman and Ellisor, n. sp. $\times 60$. *a*, side view; *b*, peripheral view.
- FIGS. 7 *a*, *b*. *Uvigerina vicksburgensis* Cushman and Ellisor, n. sp. $\times 40$. *a*, side view; *b*, apertural view.
- FIGS. 8 *a-c*. *Eponides vicksburgensis* Cushman and Ellisor, n. sp. $\times 60$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 9 *a-c*. *Valvulineria texana* Cushman and Ellisor, n. sp. $\times 60$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 10 *a-c*. *Anomalina barrowi* Cushman and Ellisor, n. sp. $\times 60$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 11 *a-c*. *Anomalina jacksonensis* (Cushman and Applin), var. *limbosa* Cushman and Ellisor, n. var. $\times 60$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 12 *a-c*. *Cibicides yazooensis* Cushman, n. sp. $\times 60$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 13 *a-c*. *Nonionella hantkeni* (Cushman and Applin), var. *spissa* Cushman, n. var. $\times 50$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.
- FIGS. 14 *a-c*. *Discorbis hemisphaerica* Cushman, n. sp. $\times 60$. *a*, dorsal view; *b*, ventral view; *c*, peripheral view.

Figures drawn by Margaret S. Moore.



raised, longitudinal costae, usually broken at the sutures, but a few of them extending across adjacent chambers; aperture with a very short neck. Length 0.60-0.70 mm.; diameter 0.30 mm.

Holotype (Cushman Coll. No. 15,519) from Lower Oligocene, Vicksburg, from core sample from Humble Oil and Refining Company's No. 73 Sims Smith at 6,174 feet, Goose Creek, Harris County, Texas.

This species has usually been referred to as "*Uvigerina pygmaea* d'Orbigny," but it is very different from that species, the typical form of which has been recently figured in these "Contributions" (Vol. 6, 1930, pp. 62, 63, pl. 9, figs. 14-20). Our species has fewer costae, the sides nearly parallel for most of the length, and there is no tendency to develop the spinose last chamber, and a very elongate neck is characteristic of typical *U. pygmaea*.

VALVULINERIA TEXANA Cushman and Ellisor, n. sp.

Plate 7, figures 9 a-c

Test small, slightly longer than broad, periphery broadly rounded; chambers comparatively few, usually five making up the last-formed whorl in the adult, inflated on the ventral side with a distinct prolongation forming a semicircular lip, and extending out over the aperture; sutures distinct, depressed, on the dorsal side very slightly curved, on the ventral side radial; wall smooth, very finely perforate; aperture an elongate slit below the projecting lip in the umbilical region of the ventral side. Length 0.30 mm.; breadth 0.25 mm.; thickness 0.12 mm.

Holotype (Cushman Coll. No. 15,520) from Upper Eocene, core sample from Humble Oil and Refining Company's No. 6 Mueller, from 3,165-3,177 feet, Raccoon Bend, Austin County, Texas.

This is a very small but distinctive species with its few strongly inflated chambers and very distinct umbilical projection. It is not likely to be confused with any of the other American species in the Upper Eocene.

EPONIDES VICKSBURGENSIS Cushman and Ellisor, n. sp.

Plate 7, figures 8 a-c

Test small, strongly biconvex, ventral side somewhat more convex than the dorsal, periphery acute with a distinct keel in the early portion;

chambers distinct, not inflated, of uniform shape, increasing only slightly in size as added, about seven usually making up the last-formed whorl in the adult; sutures distinct, slightly limbate, not depressed, strongly oblique on the dorsal side, slightly curved on the ventral; wall finely perforate, smooth except on the ventral side which has numerous small papillae, especially on the inner end of the chambers; aperture a short, curved opening on the ventral side at the base of the chamber, midway between the umbilicus and the periphery. Diameter 0.30 mm.; height 0.15-0.18 mm.

Holotype (Cushman Coll. No. 15,521) from Lower Oligocene, Vicksburg, core sample from Humble Oil and Refining Company's No. 73 Sims Smith, from 6,174 feet, Goose Creek, Harris County, Texas.

This is a very small but distinct species in the Lower Oligocene, easily overlooked because of its small size. It has however very distinct characteristics, and should not be confused with any other species in this formation.

ANOMALINA BARROWI Cushman and Ellis, n. sp.

Plate 7, figures 10 *a-c*

Test small, almost equally biconvex, periphery broadly rounded, the early portion of the coils often showing from both sides; chambers distinct, numerous, 10-12 making up the last-formed coil in the adult, not inflated; sutures distinct, strongly limbate, those of the early portion on the dorsal side somewhat raised, the remainder flush with the surface, strongly oblique, but very slightly curved; wall distinctly and coarsely perforate, otherwise smooth; aperture a narrow opening at the peripheral margin at the base of the last-formed chamber. Diameter 0.30 mm.; thickness 0.12 mm.

Holotype (Cushman Coll. No. 15,522) from Upper Eocene, core sample from Humble Oil and Refining Company's No. 12, Thompson, from 3,048-3,060 feet, Raccoon Bend, Austin County, Texas.

This species resembles several of the other Upper Eocene species of this genus, but a comparison of the type figures with these given here will show that the differences are sufficient so that this new species may be used for definite correlation purposes. The characters are often somewhat more obscure than shown in the figures, but the general characters are held throughout any considerable series of specimens.

ANOMALINA JACKSONENSIS (Cushman and Applin), var. **LIMBOSA** Cushman and Ellis, n. var.

Plate 7, figures 11 *a-c*

Variety differing from the typical, especially in the less curved sutures which are often strongly limbate, and occasionally tend to become beaded.

Holotype of variety(Cushman Coll. No. 15,523) from Upper Eocene, core sample from Humble Oil and Refining Company's No. 6 Mueller, from 3,165-3,177 feet, Raccoon Bend, Austin County, Texas.

This variety is very close to var. *dibollensis*, but the umbonal boss is much less pronounced, and the sutures are less curved. It seems to have a very short vertical range, and should be an excellent variety for correlation purposes.

108. THREE NEW UPPER EOCENE FORAMINIFERA*

BY JOSEPH A. CUSHMAN

The following three foraminifera from the Upper Eocene of the Coastal Plain Region of the United States are here described and figured in order that they may be available for use in another paper while awaiting the publication of a large manuscript on the "Upper Eocene Foraminifera of the Coastal Plain of the United States" soon to be published by the U. S. Geological Survey.

NONIONELLA HANTKENI (Cushman and Applin), var. **SPISSA** Cushman, n. var.

Plate 7, figures 13 *a-c*

Variety differing from the typical in the much thicker test and the usually smaller number of chambers.

Some of the broader specimens are close to the typical in outline, but there is a very considerable amount of variation in any large series of specimens. The typical form occurs in the Eocene of Texas, but the material from regions to the eastward seems all to belong to the variety.

Holotype of variety from the Upper Eocene, Cooper marl, pit on U. S. Highway No. 17, about one mile South of Moncks Corner, Berkeley County, South Carolina.

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DISCORBIS HEMISPHERICA Cushman, n. sp.Plate 7, figures 14 *a-c*

Test small, typically plano-convex, convex, the dorsal side strongly convex, the base flattened or very slightly convex, periphery subacute to slightly rounded; chambers few, slightly more than four making up the adult coil, somewhat inflated; sutures distinct, very strongly oblique on the dorsal side, slightly tangential on the ventral, very slightly depressed, sutures in the earlier portion limbate; wall smooth, very distinctly perforate; aperture ventral, opening into an umbilical cavity with a slight lip running from the periphery to the umbilicus. Diameter 0.30 mm.; height 0.15 mm.

Holotype from the Upper Eocene of Jackson, Mississippi.

This is a very distinct little species with the dorsal side very convex, and a very few chambers making up the very last-formed coil. The limbate sutures of the early portion are also a characteristic feature of this species. This is widely distributed in the Upper Eocene of the Gulf Coastal Plain of the United States.

CIBICIDES YAZOOENSIS Cushman, n. sp.Plate 7, figures 12 *a-c*

Test slightly longer than broad, compressed, periphery angled, slightly lobulate, ventral side convex, dorsal side flattened or slightly convex, nearly involute on both sides; chambers distinct, usually eight in the last-formed coil; sutures distinct, curved, very strongly limbate and somewhat raised, increasing in thickness toward the inner end; wall distinctly, but finely, perforate with a clouding of the surface except at the sutures which are clear and transparent; aperture a curved, somewhat arched opening near the periphery on the ventral side. Length 0.60 mm.; breadth 0.50 mm.; thickness 0.25 mm.

Holotype from U. S. G. S. station 6473, Jackson formation, 1½ miles East of Yazoo City, Mississippi.

This species is widely distributed in the Upper Eocene from Alabama to Texas.

109. A NEW PLECTOFRONDICULARIA FROM FLORIDA

BY JOSEPH A. CUSHMAN and GERALD M. PONTON

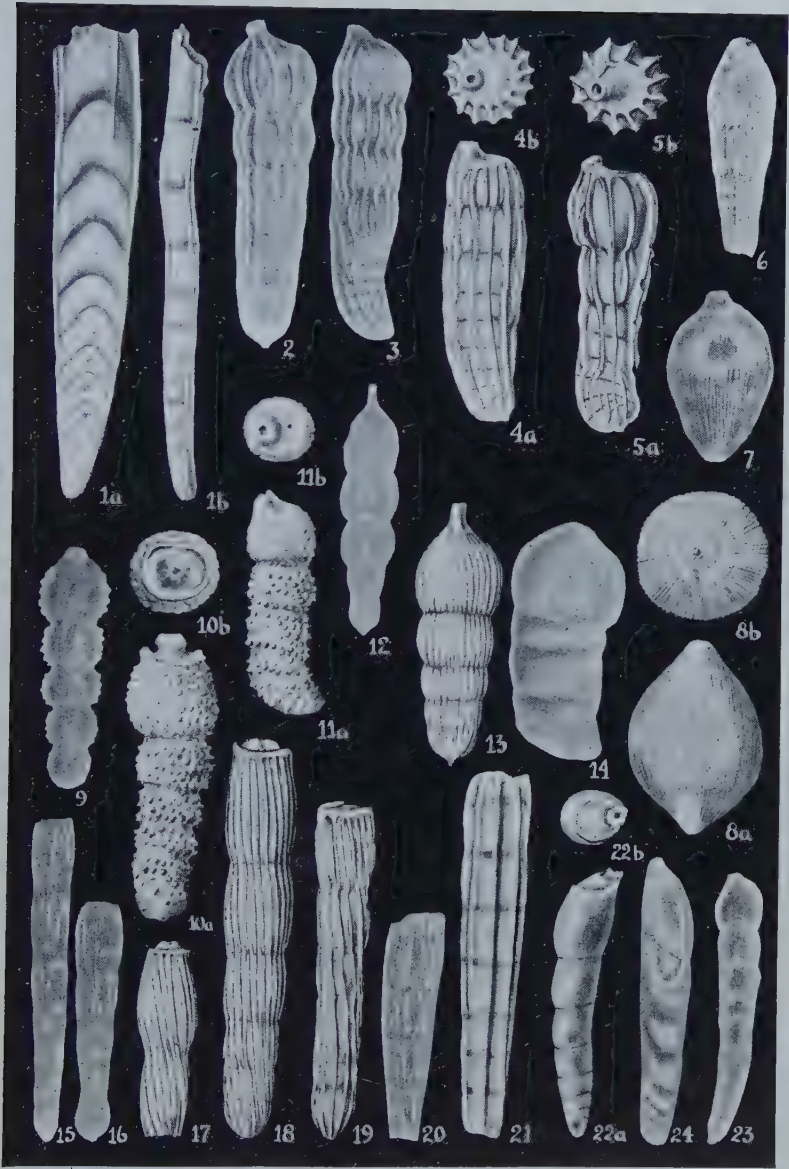
During recent investigations in the Miocene of Florida, a new species of *Plectofrondicularia* has been discovered which is quite distinct from *P. floridana* Cushman. The description of this and the differences between it and *P. floridana* follow:

PLECTOFRONDICULARIA MANSFIELDI Cushman and Ponton, n. sp.Plate 8, figures 1 *a*, *b*

Test very much compressed, much elongated, very slightly tapering, the later portion with the sides nearly parallel, sides sharply truncate or slightly concave with distinct keels, giving a narrow rectangular shape in end view; chambers numerous, the earliest ones biserial, soon becoming uniserial, and increasing rather rapidly in height toward the apertural end,

EXPLANATION OF PLATE 8

- FIGS. 1 *a*, *b*. *Plectofrondicularia mansfieldi* Cushman and Ponton, n. sp. $\times 50$.
a, front view; *b*, side view.
- FIGS. 2-5. *Marginulina costatus* (Batsch). Figs. 2, 3, (After Batsch). Figs. 4, 5, Recent specimens from Rimini. *a*, *a*, side views; *b*, *b*, apertural views. Figs. 2, 4, Megalospheric form. Figs. 3, 5, Microspheric form.
- FIG. 6. *Pseudoglandulina comata* (Batsch). (After Batsch.)
- FIGS. 7, 8. *Pseudoglandulina glans* (d'Orbigny). Fig. 7, (After Batsch). Fig. 8, Recent specimens from Rimini. *a*, side view; *b*, basal view. $\times 35$.
- FIGS. 9-11. *Marginulina murex* (Batsch). Fig. 9, Megalospheric form, (After Batsch). Figs. 10, 11, Recent specimens from Rimini. $\times 30$. *a*, *a*, side views; *b*, *b*, apertural views. Fig. 10, Megalospheric form. Fig. 11, Microspheric form.
- FIGS. 12, 13. *Nodosaria scalaris* (Batsch). Fig. 12, (After Batsch). Fig. 13, Recent specimen from Rimini. $\times 35$.
- FIG. 14. "*Nautilus* (*O.*) *vaginaeformis* Batsch." (After Batsch.)
- FIGS. 15-19. *Nodosaria obliquata* (Batsch). Figs. 15, 16, (After Batsch). Figs. 17-19, Recent specimens from Rimini. $\times 30$.
- FIGS. 20, 21. *Dentalina vertebralis* (Batsch). Fig. 20, (After Batsch). Fig. 21, Recent specimen from Rimini. $\times 25$.
- FIGS. 22, 23. *Dentalina communis* d'Orbigny. Fig. 22, Recent specimen from Rimini. $\times 25$. *a*, side view; *b*, apertural view. Fig. 23, (After Batsch).
- FIG. 24. *Vaginulina leguminiiformis* (Batsch). (After Batsch.)



somewhat inflated; sutures very distinct, slightly depressed especially in the later portion, usually not distinctly limbate, convexly curved; wall mostly smooth, but the basal end with 1 or 2 very short costae, and in the adult the later chambers occasionally with fine costae; aperture not shown. Length up to 1.50 mm.; maximum breadth 0.25 mm.; thickness 0.12 mm.

Holotype (Cushman Coll. No. 15,483) from the Miocene of Old Frazier Farm N.W. $\frac{1}{4}$ of S.E. $\frac{1}{4}$ Sec. 18, T. 2 N., R. 19 S., Florida.

This species is a very distinct one from *Plectofrondicularia floridana* in the sides which in this species are distinctly truncate and concave, while in *P. floridana* there is a distinct high median keel in addition to the two keels at either side. The sutures also in this species are much more curved, not limbate, and much compressed, all characters very distinct from those of *P. floridana*. The chambers also in our species are much higher than those of *P. floridana*.

110. NOTES ON THE FORAMINIFERA DESCRIBED BY BATSCH IN 1791

By JOSEPH A. CUSHMAN

In reviewing the older literature on the foraminifera, the first work which has a definite place in determining definite names for the foraminifera after those of Linné and Gmelin is that of Batsch. His work entitled: "Sechs Kupfertafeln mit Conchylien des Seesandes" published in 1791, contains six plates with short descriptions of the species figured. These figures are excellently drawn, and there is very little doubt about the species which they represent. As this work of Batsch was published before that of Fichtel and Moll, Lamarck, Defrance, and d'Orbigny, it is very necessary to fix definitely just what these species of Batsch really are. Unfortunately he gives no data in regard to the source of his material, but from a comparison of faunas, it is very probable that his material came from either Rimini or some other locality on the Adriatic, and is of Recent origin. Most of his species can be found in the shore collections from Rimini, which was the most prolific source of Recent material described by many of the earlier authors.

In 1865, Parker, Jones and Brady devoted one of their series of articles: "On the Nomenclature of the Foraminifera. XI. The Species Enumerated by Batsch in 1791" to a review of this work. They give descriptions in English translated from the originals of Batsch, and make numerous notes as to their understanding of the species. Like much of the work reviewed by these authors, it is to be suspected that it is based more on a review of the literature than upon a comparative study of specimens from various type localities. In this present work, the descriptions given by Parker, Jones and Brady are here copied, and notes are given as to what seem to be the characters of Batsch's species from a study of material collected by the author in Rimini on the Adriatic in 1927.

Fornasini has published in his series of papers, many notes on the foraminiferal fauna of Rimini. He also published a series of papers on the "Planches Inedites" of d'Orbigny. Many of the species of d'Orbigny's 1826 work are based on material from Rimini, as are also some earlier species of DeFrance and Fichtel and Moll. Most of these authors paid little attention to the works which had preceded theirs, and the work of Batsch was very little recognized by any of them. This is probably due to the rarity of his published work. As a result, many of his species are later given different names by subsequent authors. These short notes are however intended more to supply many of the younger workers with an idea of what these species of Batsch really are rather than to go into the detailed synonymy of these species. However, reference is made to some later names, especially to those of d'Orbigny, which have been applied to them. The work of Soldani, while not in itself binomial, was referred to by d'Orbigny in his 1826 work. Many of Soldani's figures are of Recent material from Rimini and elsewhere, and as a result in this way d'Orbigny gave names to certain of the species which had already been described by Batsch.

In order to give an idea of these species, photographic copies of those which he described are here given, but only selected ones of his somewhat larger series. These are supplemented by drawings of typical specimens from Rimini which seem to be identical with Batsch's species. The various forms are taken up in the order that they appear in the original of 1791, which is the same order in which they were taken up by Parker, Jones and Brady.

The first name that appears under each number is that given by Batsch, and the following is the accepted name in the present classifica-

tion. As already noted, the translation in quotation marks is copied from Parker, Jones and Brady, but the notes given are our own.

1. *Nautilus (Orthoceras) costatus* Batsch. [*Marginulina costatus* (Batsch).]

"The chambers or joints are round, bullet-shaped, and separated from one another, and are bound by strong ribs, which extend without interruption over the whole of the shell, and have for the most part smooth edges. The forms differ both in contour and colour, which here, less than in other natural objects, determine the general character. Fig. 1 is ground down to show the construction of the interior. In Plates 1 and 2 the small horizontal lines show the natural sizes."

This is one of the most abundant species in the shore sands of Rimini. It is a very variable species as the microspheric and megalospheric forms are quite different in their early development. Two of these are shown in the drawings as well as in the figures given from Batsch. The test is marked by heavy longitudinal ribs, and the aperture is excentric. d'Orbigny gave the name "*Marginulina bifurcata*" to an identical form which he notes is from the Adriatic (Ann. Sci. Nat., vol. 7, 1826, p. 258; Fornasini, Mem. Accad. Sci. Bologna, ser. 5^a, vol. 10, 1902, p. 38, fig. 30 [in text]). d'Orbigny's model No. 6, which he called "*Marginulina Raphanus*" is very much like Batsch's species. However, Linné's species was based upon figures given by Plancus and Gualtieri, both of which show costate nodosarian forms with no sign of either an excentric aperture or of any coiling. It seems therefore that on the evidence, d'Orbigny's species may be the same as that of Batsch, but is not the same as the earlier "*Nautilus Raphanus* Linné"

Of those species named by d'Orbigny and based on the figures of Soldani, the one referred to "*Marginulina Raphanus* Linné" is again Batsch's species, and not that of Linné. It is a megalospheric form. The other species called by d'Orbigny "*Marginulina subtilius*" and based upon Soldani's figure is a microspheric form very similar to the microspheric form which we have figured here.

2. *Nautilus (O.) comatus* Batsch. [*Pseudoglandulina comata* (Batsch)+*P. glans* (d'Orbigny).]

"The cylindrical joints run more together, and the whole is covered with riblets, which are continuous, except over the end portions of the

terminal chamber. Probably fig. 7 *b* (on plate 3) is simply a variety. Both specimens are ground away."

Two distinct species are figured by Batsch. One of these is much more elongate and more coarsely costate than the other. Both show evidences of overlapping of the chambers. The usual use of Batsch's name is to apply it to the short, delicately costate form following Brady's designation in the *Challenger* Report. However, Parker, Jones and Brady in their 1865 review of Batsch's work definitely assign the name "*comata*" to the more elongate form, and designate figures 2 *a*, and 2 *b*. To the short stout form they assign d'Orbigny's name of "*Glandulina glans*" represented by his Model No. 51. According to the Rules of Nomenclature, this very definitely disposes of this species. We have found the shorter, finely costate form in our Rimini collections, but not the more elongate typical form.

3. *Nautilus* (*O.*) *murex* Batsch. [*Marginulina murex* (Batsch).]

"The chambers are round and bullet-shaped, covered with warts, and separated by smooth belts. The specimen ground down is curved."

Specimens of this species occur at Rimini, but are not common. Both microspheric and megalospheric forms are figured here. Batsch's figured form was a megalospheric one.

4. *Nautilus* (*O.*) *scalaris* Batsch. [*Nodosaria scalaris* (Batsch).]

"The round, bullet-shaped chambers are provided with delicate ribs, running perpendicularly and joining where the chambers meet,"

This is a very definite species at Rimini with its spinose, initial end, few chambers, with numerous costate and the elongate, slender neck. As suggested by Parker, Jones and Brady, the species named by d'Orbigny "*Nodosaria longicauda*" and based on Soldani's figures is a synonym of *N. scalaris* (Batsch). It is possible that d'Orbigny's *Nodosaria gibba*, which is from Rimini, may also be a more finely costate form of *N. scalaris*.

5. *Nautilus* (*O.*) *obliquatus* Batsch. [*Nodosaria obliquata* (Batsch).]

"This very much elongated shell has longish chambers, which run almost into one another; and it is provided with string-like ribs, which run in a not quite straight direction down the shell."

This is a fairly common species at Rimini, and several specimens are here figured. All are megalospheric, and none of them has the apertural end complete. Batsch's figured specimens were also lacking in this same respect, showing that there is a decided line of weakness along the sutures in the later chambers.

6. *Nautilus* (O.) *vertebralis* Batsch. [*Dentalina vertebralis* (Batsch).]

"A prolonged almost unjointed shell, which has a few continuous somewhat waved ribs. The partition-walls are broad and transparent."

The name "*Nodosaria vertebralis*" has been very widely used. As usually applied, the species is a *Dentalina*, the microspheric form at least being decidedly arcuate. Batsch's figure which is reproduced here is of a specimen with both ends missing, the sutures marked by clear shell material, and the costae very definitely continued throughout the length of the test. We have searched our Rimini collections without finding complete specimens that could be used to obtain the full characters of this species. Our figured specimen gives little additional information, but it evidently belongs to Batsch's species. Parker, Jones and Brady assign this species as a synonym of Linné's *Nodosaria fascia*. Linné

EXPLANATION OF PLATE 9

- FIGS. 1-4. *Nodosaria globifera* (Batsch). Fig. 1, (After Batsch). Figs. 2-4, Recent specimens from Rimini. $\times 25$.
- FIG. 5. "*Nautilus* (O.) *Radicula* Batsch." [Not *N. radicula* Linné.] (After Batsch.)
- FIG. 6. *Articulina conico-articulata* (Batsch). (After Batsch.)
- FIGS. 7-9. *Vaginulina margaritifera* (Batsch). Figs. 7, 8, (After Batsch). Fig. 8, Section. Fig. 9, Recent specimen from Rimini. $\times 30$.
- FIGS. 10-13. *Vulvulina pennatula* (Batsch). Fig. 10, Recent specimen from Rimini, $\times 30$. a, side view; b, apertural view. Figs. 11-13, (After Batsch). Figs. 12, 13, Sections.
- FIG. 14. *Frondicularia complanata* DeFrance. (After Batsch.)
- FIG. 15. *Flabellina harpa* (Batsch). (After Batsch.)
- FIG. 16. *Planularia auris* (Fichtel and Moll). (After Batsch.)
- FIGS. 17, 18. *Peneroplis planatus* (Fichtel and Moll). (After Batsch.) Fig. 17, Section.
- FIG. 19. *Peneroplis arietinus* (Batsch). (After Batsch.)
- FIGS. 20, 21. *Peneroplis semi-lituus* (Gmelin). (After Batsch.) Fig. 20, Section.
- FIG. 22. *Monalysidium lituus* (Gmelin). (After Batsch.)



based his species on a figure given earlier by Gualtieri, which has raised bands at the sutures. This may be due to inaccuracy in the drawing, but it is difficult to put the two together, and *Dentalina vertebralis* (Batsch) should stand until further evidence can be secured as to the real characters of Linné's specimens.

7. *Nautilus* (O.) *vaginaeformis* Batsch.

"The shell is broad and flat, with scarcely separated chambers, the broad and blunt under surfaces of which reach far into succeeding chambers."

There are probably two species in the specimens figured by Batsch, and nothing identical with them was found in the Rimini collections. It is possible that 7 *b* is a *Lingulina*, and that 7 *c* and 7 *d* are microspheric forms. We have not been able to solve this problem from our Rimini collections.

8. *Nautilus* (O.) *leguminiiformis* Batsch. [*Vaginulina leguminiiformis* (Batsch)+*Dentalina communis* d'Orbigny.]

"The smooth, almost coincident joints of this elongated shell are nearly cylindrical, and fit into each other like sheaths."

Parker, Jones and Brady have already settled the disposition of these two forms. We have found the *Dentalina communis* form at Rimini, but not the other.

9. *Nautilus* (O.) *globifer* Batsch. [*Nodosaria globifera* (Batsch).]

"The chambers are elongated and somewhat distinct; only the last [properly the first], the lowest in the drawing, is bullet-shaped. At the top it is button-shaped."

This species was found in our Rimini collections in some numbers, but no complete specimens. The megalospheric specimens have a very large, globular proloculum as shown in the figures. Parker, Jones and Brady assign to this species that named by d'Orbigny from Soldani's figure as "*Nodosaria ovicula*." Soldani's specimen is from the Pliocene of Siena, and the species he figures seems to be a distinct one from this Recent one of Rimini. The Siena species becomes very elongate, and its variations have been well figured by A. Silvestri in his large work on the Pliocene of the Siena region.

10. *Nautilus* (O.) *radicula* Batsch.

"The chambers are bullet-shaped, very distinct, and unusually strong."

No specimens were found in the collection from Rimini which exactly

fit this form by Batsch. As noted by Parker, Jones and Brady, the specific name "*radicula*" had already been used by Linné for a nodosarian form. They unite this Recent form from the Adriatic with the Cretaceous *Nodosaria limbata* d'Orbigny, but they do not seem to be the same.

11. *Nautilus* (O.) *conico-articulatus* Batsch. [*Articulina conico-articulata* (Batsch).]

"The chambers are shaped like inverted cones, and the walls are folded into oblique furrows. It was quite impossible to grind away this shell, as it was too brittle."

Various forms have been assigned to this species by later authors. As the early chambers are not shown by Batsch, it is not entirely clear that this belongs to the genus *Articulina*, but it is more probably this than a *Vertebralina*. Such forms occur commonly in the Mediterranean, although none exactly like this were found in the collections from Rimini.

12. *Nautilus* (O.) *margaritiferus* Batsch. [*Vaginulina margaritifera* (Batsch).]

"This strong, elongated, and almost unjointed shell is flattened, and has two sharp edges, and has in the middle high and projecting partition-walls, the feeble continuations of which can be seen at one edge."

This form figured by Batsch is evidently rather closely related to *Vaginulina legumen* (Linné), the types of which were from the Adriatic. The form figured by Batsch and also figured here from Rimini is one common in the Adriatic and in the Late Tertiary of Italy. It may prove to be only a varietal form of Linné's species. The early portion has rather definite, longitudinal costae toward the margin of each chamber, and the ornamentation in general is much more marked than in the typical form.

13. *Nautilus* (O.) *Pennatula* Batsch. [*Vulvulina pennatula* (Batsch).]

"The partition-walls, which at the beginning of its growth are strangely crowded together, make at the upper end of the shell an altered feather-like portion. Figure *e* represents one of these parts alone."

Our figure of an adult form from Rimini adds somewhat to the characters as given by Batsch. His figures show in section both microspheric and megalospheric forms. The microspheric form has several coiled chambers before the biserial form is taken on. Usually in the microspheric form but 1 or 2 chambers in the adult show the uniserial cham-

bers. Our figured specimen shows three. The megalospheric form has fewer biserial chambers, and therefore attains the uniserial stage much earlier. The aperture in the biserial portion is similar to that of *Textularia*, to which it is evidently closely related. In the adult, uniserial portion, the aperture becomes elongate, central, and terminal.

d'Orbigny figures a very similar form also from the Adriatic as "*Vulvulina capreolus*," and gives a model of it.

It has been customary for later authors to distinguish between these two species probably based on the figures given by Brady. As the microspheric and megalospheric forms differ so considerably in the number of chambers, and also in the relative shape and size, a careful study of the Recent forms would seem to be desirable before definitely committing oneself to a final statement in regard to the relationship of these two species. It is quite possible that this common form from the Adriatic is not the same as that developed for example in the Western Atlantic, and the much larger and peculiarly shaped forms known from the Philippines.

It may also be noted here that Figure 13 *e* seems to be a specimen of *Textularia carinata*.

14. *Nautilus* (O!) *Harpa* Batsch. [*Flabellina harpa* (Batsch)+*Frondicularia complanata* Defrance+*Planularia auris* Defrance.]

"The shell is quite flat, bright, and smooth. The partition-walls run obliquely, are parallel, and shine through the otherwise opaque shell. In this and in figure 13 may be clearly seen how little nature has made the evident character depend upon either form or colour."

Parker, Jones and Brady have already dealt with the five drawings: 14 *a-e*. They have by selection taken out 14 *a*, as being the same as *Frondicularia complanata* Defrance, and 14 *d* and *e* as *Planularia auris* Defrance. This leaves 14 *b* and *c* as the types of *Flabellina harpa* (Batsch).

At Caen in 1927, I studied, through the kindness of Professor Bigot, the original collections of Defrance, which were preserved in the University of Caen. The types of Defrance's *Frondicularia complanata* are marked as coming from Rimini. There are three specimens on the type slide, and they show that this species is identical with the form figured by Batsch and selected by Parker, Jones and Brady as the same as Defrance's species. The proloculum is strongly costate with a few short, raised ribs, and the basal margin of the test somewhat notched as the

chambers do not all come down to the same level. This species is well characterized, and there seems to be no doubt as to the type form.

In the same collection of DeFrance, is a slide with specimens which he himself identified as the equivalent of Fichtel and Moll's species. *Planularia auris* (Fichtel and Moll) is therefore a well characterized species, the figures of Batsch being even better than the type figures given by Fichtel and Moll. The chambers increase rapidly in length, but fail to continue back entirely to the proloculum on the inner margin. The outer margin is curved, and there are usually two supplementary keels, one at either side of the main one. The early portion of the test has several curved, raised costae running across a number of chambers, and becoming obsolete after a few chambers are developed, continuing longest along the inner margin of the test. Such specimens are fairly common at Rimini, and also occur in the Late Tertiary of Italy.

This leaves then for the types of *Flabellina harpa* (Batsch) the rather anomalous forms figured by Batsch in 14 *b* and 14 *c*. These forms have the early portion somewhat like that of the form already assigned to *Planularia auris* (Fichtel and Moll). The ornamentation is very similar, but instead of the chambers becoming elongate on one side, only in this particular form they are elongate on both sides and become frondicularian. The figured one indicates that this form is megalospheric while those assigned to *Planularia auris* are microspheric. However in several bags of material collected at Rimini, a careful search failed to show any such forms. Therefore the definite relationship of these two forms must be left until more material can be studied that will show whether or not these two forms are definitely related.

15. *Nautilus* (*Lituus*) *arietinus* Batsch [*Peneroplis arietinus* (Batsch) + *P. planatus* (Fichtel and Moll) + *P. semi-lituus* (Gmelin).]

"In all the different forms two characters remain quite evident, namely, the strong shell and its numerous folds or wrinkles. It is also much coiled.

The forms given by Batsch, Nos. 15 and 16, all belong to the general *Peneroplis* group. The various forms given by Batsch which belong to the genus *Peneroplis* have been a subject of considerable study by Heron-Allen and Earland in connection with their work on the Recent Foraminifera of the Kerimba Archipelago. They have refigured a number of the early drawings on which Linné and Gmelin based their species of this group. Very little can be added to their treatment of this subject,

except in regard to the definite assignment of the name "*arietinus*." In their review of Batsch's work, Parker, Jones and Brady definitely designated Figure 15 *c* of Batsch as the one to which the name "*arietinus*" should be referred, and left Figures *d*, *e*, and *f* as "*Spirolina Hemprichii* Ehrenberg." Other authors have referred these particular figures to Lamarck's *Spirolina cylindracea*. It is very questionable whether or not these are actually identical with the Eocene species.

16. *Nautilus (Lituus) acicularis* Batsch [*Monalysidium lituus* (Gmelin).]

"This is a linear or awl-shaped shell, extraordinarily delicate, with projecting riblets. The curvature of the top forms a small head, somewhat in the form of a knot."

In spite of the fact that Heron-Allen and Earland have discussed this form at some length, it seems that the original species of Gmelin cannot be ignored according to the Rules of Priority. This species of Gmelin having been very definitely included in genus *Monalysidium*, it would seem that it can hardly be ignored. It is very evidently the same as Batsch's species. Although, as pointed out by Heron-Allen and Earland, *Monalysidium* in some of its species never shows a coiled portion, such a beginning cannot be entirely eliminated, as the specimens break so easily. None of the straight forms show any definite proloculum, and it is therefore to be supposed that the early beginnings in all cases have been broken away.

RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works on the foraminifera that have come to hand.

Jaworski, E.

Bibliographia Palaeontologica für die Jahre 1914-1926 by E. Jaworski. Erste Lieferung. Allgemeine Paläontologie. Spezielle Paläozoologie: Protozoa, Coelenterata, Echinodermata, Molluscoidea, Mollusca (ausser Cephalopoda).

(Published by Max Weg, Leipzig, Germany. Price: 18 Marks.)

The part on foraminifera takes up pages 53-77 with papers numbered 781-1152 arranged under various groupings.

Hada, Yoshine.

Report of the Biological Survey of Mutsu Bay. 19. Notes on the Recent Foraminifera from Mutsu Bay.

(Sci. Rep. Tohoku Imperial Univ., Fourth Series, Biology, vol. VI, No. 1, March, 1931, pp. 45-148, text figs. 1-95.) *Sendai.*

Describes 100 species, and figures nearly all. Eleven species new.

Hada, Yoshine.

A Contribution to the Study on the Plankton and the Allied Protozoa in the Northern Waters of Japan. I. A List of the Littoral Foraminifera of Hokkaido.

(Trans. Sapporo Nat. Hist. Soc., vol. XI, pt. I, July, 1929, pp. 9-15, text figs. a-d.) *Sapporo.*

Lists 72 species, one new species of *Reophax*.

Le Maitre, D.

Observations sur les Algues et les Foraminifères des calcaires dévoniens.

(Ann. Soc. Géol. du Nord, vol. LV, 1930, pp. 42-50, pl. III.) *Lille.*

A few arenaceous foraminifera are recorded and figured.

Le Maitre, D.

Foraminifères des terrains dévoniens de Bartine (Turquie).

(Ann. Soc. Géol. du Nord, vol. LVI, 1931, pp. 1-8, pl. I.) *Lille.*

Six genera, all arenaceous are recorded, and figures given of photographed sections.

Cushman, Joseph A. and Boris Laiming.

Miocene Foraminifera from Los Sauces Creek, Ventura County, California.

(Journ. Pal., vol. 5, No. 2, June, 1931, pp. 79-120, pls. 9-14, 5 text figs.) *Tulsa.*

Record and figure 68 species, of which 10 species and 6 varieties are described as new.

Cole, W. Storrs.

The Pliocene and Pleistocene Foraminifera of Florida.

(Bull. 6, Florida State Geol. Survey, April, 1931, pp. 1-79, pls. 1-7, table.) *Tallahassee.*

Describes and figures numerous species and varieties, of which 5 are given as new.

Hofker, J.

Resultats Scientifiques du Voyage aux Indes Orientales Neerlandaises. Vol. II, Fasc. 1. Sur Quelques Foraminifères, Dec. 31, 1930, pp. 1-12, pls. I-III. *Brussels.*

Notes and figures are given of 11 tropical species.

Hofker, J.

Die Foraminiferen aus dem Senon Limburgens. XI. Einige Textulariden.

(Nat. Hist. Maandblad, Jaarg. 20, No. 5, May 21, 1931, pp. 74-79, 8 text figs.) *Limburg.*

Notes and figures on several Cretaceous species.

Dryden, A. L., Jr.

Glaucinite in Fossil Foraminiferal Shells.

(Science, vol. 74, No. 1905, July 3, 1931, p. 17.) *Lancaster.*

Gives data for the occurrence of glauconite in Miocene and Eocene foraminifera.

Cushman, Joseph Augustine.

The Foraminifera of the Atlantic Ocean. Part 8. Rotaliidae, Amphisteginidae, Calcarinidae, Cymbaloporettidae, Globorotaliidae, Anomalinidae, Planorbulinidae, Rupertiidae and Homotremidae.

(Bull. 104, U. S. Nat. Mus., pt. 8, 1931, pp. i-ix, 1-179, pls. 1-26.) *Washington.*

The final part of this work with many species and varieties, mostly illustrated and a few new.

J. A. C.

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